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Is transfemoral aortic valve implantation possible without contrast medium in patients with renal and multiorgan failure?

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Transfemoral aortic valve implantation has recently emerged as a therapeutic option for patients with symptomatic, severe aortic stenosis for whom standard surgical aortic valve surgery is not suitable. Aortic valvuloplasty and valve positioning is normally performed under fluoroscopy and requires several injections of contrast medium. In critically ill patients with advanced renal insufficiency, contrast media administration can further increase renal damage; therefore, an echocardiogram and fluoroscopy-guided procedure, using the calcified contours of the stenotic aortic valve as a landmark may be a useful alternative. We report the first successful transfemoral aortic valve implantation procedure performed under fluoroscopy and transesophageal echocardiogram control, without administration of contrast medium injections in a patient with severe renal insufficiency and multiorgan failure.

The transfemoral aortic valve implantation (TF-AVI) is increasingly embraced as a viable technique for aortic valve replacement (AVR) in selected high-risk patients. The positioning and implantation of valve prosthesis is normally based on landmarks identified preoperatively by a cardiac CT scan, aortic and coronary angiography and confirmed intraoperatively by fluoroscopy and injections of contrast medium. Aortic annulus diameter, valve leaflets anatomy, pattern of calcifications, distance between the annulus and the coronary ostia are useful landmarks [1]. Transesophageal echocardiography (TEE) is useful for final measurements and control of valve functioning intraoperatively [2]. After administration of contrast medium, patients with chronic renal insufficiency selected for transcatheter AVR are exposed to a higher risk of acute postoperative renal failure [3,4], which increases the risk of postoperative mortality [5], so every effort should be made to reduce the quantity of contrast. Indeed, moderate-to-severe renal insufficiency with serum creatinine levels >3 mg/dl was an exclusion criteria in the recently published PARTNER Trial [6]. Cases of aortic valve implantation through the transapical approach [7,8] and endovascular aortic repair [9] without contrast medium use have been reported. However, we are not aware of published cases of TF-transcatheter aortic valve implantation (TAVI) without the intraoperative administration of contrast medium.

We reported a case of TF-TAVI under fluoroscopy and echocardiographic control without contrast media in a patient with severe renal failure as a consequence of multiorgan failure.

Case report

A 77-year-old female with a known history of severe aortic valve stenosis (aortic orifice area of 0.6 cm²/m², peak gradient 45 mmHg), coronary artery disease (1-drug-eluting stent in the left anterior descending [LAD] artery, another in the circumflex artery), diabetes, chronic severe renal failure and liver failure was admitted in profound cardiogenic shock. During transportation, the emergency medical services reverted several episodes of sustained ventricular tachycardia with DC shocks.

On admission, blood pressure was 65/40 mmHg with atrial fibrillation; left ventricular ejection fraction was 14%, creatinine kinase isoenzyme MB: 63 µg/l (upper normal limit: <5); TnI: 33.2 µg/l (<0.5); serum creatinine: 4.7 mg/dl without dialysis; total plasma-bilirubin: 44.3 µmol/l (1–17); and serum alkaline phosphatase: 1900 U/l (5–40).

An emergency aortic balloon-valvuloplasty was performed through the left femoral artery (14 Fr) with a 25 mm balloon. The transvalvular gradient reduced from 33 to 5 mmHg, blood pressure raised to 95/60 mmHg, while heart rate decreased to 100 bpm without significant aortic regurgitation by TTE. Subsequently, coronary

Case Report

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Keywords

■ contrast medium ■ renal insufficiency ■ severe aortic stenosis ■ transesophageal echocardiography ■ transfemoral aortic valve replacement

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angiography showed a patent left circumflex coronary artery and right coronary artery and a thrombotic subocclusion of the drug-eluting stent in the mid LAD artery with TIMI 2 flow. Aortic–iliac angiography showed moderately tortuous and calcified arteries. Percutaneous coronary intervention was not performed as the amount of contrast media given was near to the 4 ml/kg limit and was not under dialysis [10]. After 3 days, although signs of renal and liver failure persisted, after hemodynamic stabilization, balloon percutaneous coronary intervention of the LAD artery was performed.

During a 2-week stay, the patient had two episodes of pulmonary edema with hypertensive peaks. Aortic gradient, however, increased from 5 mmHg after valvuloplasty to 20 mmHg suggesting both a partial valve recoil and left ventricular ejection fraction improvement. The heart team was consulted for the definite treatment of the aortic valve stenosis. In view of a comorbidities and high logistic EuroScore of 68% the heart team decided for a transfemoral transcatheter aortic valve implantation (TAVI), which was accepted by the patient.

The procedure was performed under general anesthesia through a surgically explored right femoral artery. A 12° cranial 10° left anterior oblique projection obtained by angiography at the time of the emergency valvuloplasty was selected to properly visualize the aortic valve (FIGURE 1A). The aortic annulus diameter was 21 mm with TEE intraoperatively (FIGURE 2A). A pigtail catheter was placed in the ascending aorta for emergency, procedure saving contrast injection. The aortic valve was crossed and a balloon valvuloplasty with a 20-mm balloon was performed under rapid pacing and TEE monitoring (FIGURE 1B). After a 23-mm Edwards SAPIEN XT transcatheter valve, with Nova Flex® transfemoral delivering system (Edwards Life sciences Inc., CA, USA) was implanted under fluoroscopy control, using an aortic annulus calcifications as landmarks (FIGURE 1C) and TEE imaging (FIGURE 2B).

After valve deployment under rapid pacing (FIGURE 1D), the TEE confirmed the correct valve placement with a peak gradient of 10 mmHg and minimal of paravalvular leakage (FIGURE 2C & D). No contrast media was given during the whole procedure. The vascular access was closed surgically.

Immediate postintervention recovery was uneventful with on-table extubation. The postoperative serum creatinine level was stable (1.9 mg/dl on day 1, 1.6 mg/dl on day 2 and 1.5 mg/dl on day 3) and an echocardiogram confirmed an aortic peak and mean gradient of 10 mmHg and 7 mmHg, respectively, with minimal paravalvular leakage.

During the following days, the patient had marked improvement in liver and renal function and no ischemic changes in the ECG. The patient was transferred to a rehabilitation center in stable condition.

Discussion

The present case demonstrates the feasibility of guiding TF-AVI with fluoroscopy and TEE without administration of contrast media, and may represent an advancement of the possibilities offered by the TAVI procedure in patients with renal insufficiency.

Indeed, recently published reports have shown an incidence of postoperative renal failure in as many as 30% of cases, often requiring transitory or permanent dialysis [3,4]. The average contrast medium dose given during a standard TAVI procedure is 100–300 ml [1], a volume that may prove deleterious in old and fragile patients [4] and even increase the risk of postoperative mortality [5],

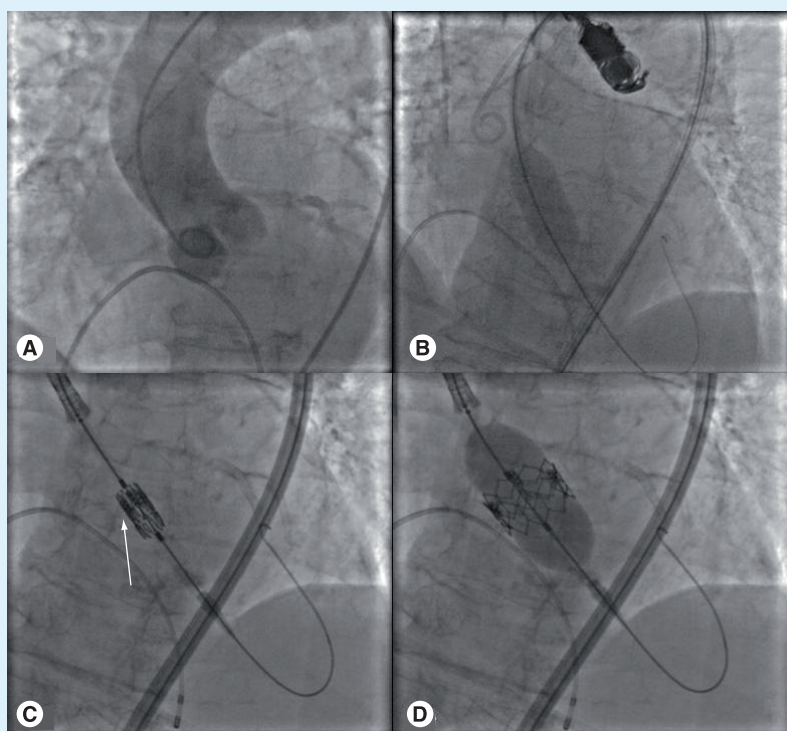


Figure 1. Fluoroscopic aortic valve prosthesis deployment.

(A) Pretranscatheter aortic valve implantation aortogram in left anterior oblique projection of fluoroscopy: 10° and cranial: 12° showing tricuspid aortic valve with minimal regurgitation. (B) Balloon valvuloplasty before implantation of aortic valve prosthesis. (C) Positioning of aortic valve prosthesis taking aortic valve calcification as landmark (arrow). (D) Deployment of aortic valve prosthesis under rapid pacing.

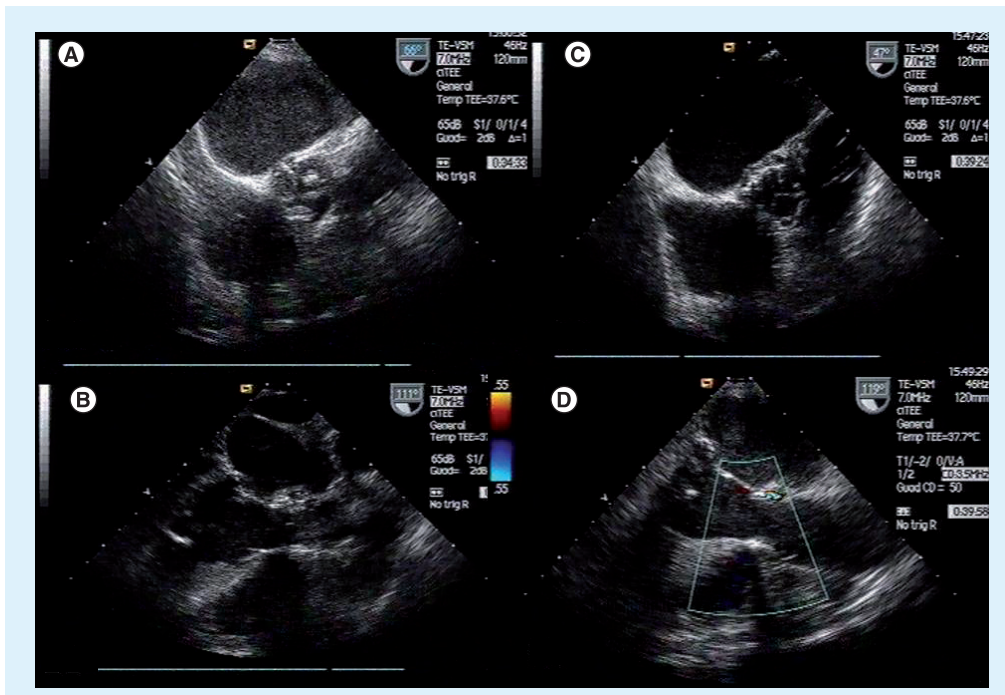


Figure 2. Transesophageal echocardiographic aortic valve prosthesis deployment.

(A) Transesophageal echocardiography showing severely calcified tricuspid aortic valve before transcatheter aortic valve implantation. (B) Positioning of aortic valve prosthesis under echo guidance. (C) Transesophageal echocardiography short axis of implanted aortic valve prosthesis. (D) Transesophageal echocardiography long axis of implanted aortic valve prosthesis showing mild peripheral aortic regurgitation.

which may be excluded from the procedure because of renal dysfunction as demonstrated in the PARTNER trial [6].

In order to minimize contrast-induced renal damage in a patient with pre-existing renal failure, we successfully attempted a totally fluoroscopy and echocardiogram-guided TF-AVI without contrast medium, obtaining almost complete return to acceptable creatinine values after normalization of the hemodynamic status. Previous experiences using transapical TAVI without administration of contrast media are available [7,8] but this is, to our knowledge, the first reported case performed from the femoral access.

The rationale of performing a TF-AVI without or with minimum administration of contrast medium (if absolutely needed) should be evaluated in the context of extremely critical clinical

situations such as the one reported here, in which we demonstrate the feasibility of this option. More reports are required to further analyze this technique.

Acknowledgement

The authors would like to thank Eulogio Garcia for overseeing the procedure.

Financial & competing interests disclosure

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

No writing assistance was utilized in the production of this manuscript.

Executive summary

- Transcatheter aortic valve implantation (TAVI) is widely accepted as viable technique in high-risk aortic stenosis patients.
- The patients undergoing TAVI usually suffering from severe comorbite conditions perhaps chronic renal failure is frequent.
- Several contrast injections are needed before and after prosthesis deployment during TAVI especially during a transfemoral TAVI. Furthermore, a recently published clinical trail described a contrast administration in chronic renal failure during TAVI increase risk of acute postoperative renal failure.
- Transesophageal echocardiography and fluoroscopy may be useful option in these patients for proper deployment of prosthesis.

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